Citation:

Kral TV, Stunkard AJ, Berkowitz RI, Stallings VA, Moore RH, Faith MS. Beverage consumption patterns of children born at different risk of obesity. *Obesity.* 2008 Aug;16 (8): 1,802-1,808.

PubMed ID: 18535546

Study Design:

Cross-Sectional Study

Class:

D - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

NEUTRAL: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

- To compare whether children who were born at either high risk or low risk of obesity differ in their beverage consumption patterns at ages three to six years
- To test whether changes in beverage consumption patterns from ages three to five years were associated with changes in children's BMI Z-score and waist circumference.

Inclusion Criteria:

- This study is part of a longer longitudinal study and inclusion criteria is described elsewhere
- For this study, children with food records of at least two days of reported intakes were included in analyses.

Exclusion Criteria:

This study is part of a longer longitudinal study and exclusion criteria is described elsewhere.

Description of Study Protocol:

Recruitment

This study is part of a longer longitudinal study and subject recruitment is described elsewhere.

Design

- This study investigated children who were born at low risk and high risk of obesity. Children's dietary intake (determined using three-day weighed food records) and height, weight and waist circumference (measured by investigators) were tracked from ages three to six years to determine whether children who were born at either high risk or low risk of

obesity differ in their beverage consumption patterns at ages three to six years, and whether changes in beverage consumption patterns from ages three to five years were associated with changes in children's BMI Z-score and waist circumference
- Children's obesity risk was determined using pre-pregnancy BMI. High-risk children had mothers with an average BMI of 31.2kg/m^2, and low-risk children had mothers with an average BMI of 19.4kg/m^2.

Dietary Intake/Dietary Assessment Methodology

- Dietary intake was assessed using three-day weighed food records completed by the child's primary caretaker who was trained extensively and provided with electronic food scales
- Food records were analyzed by registered dietitians (RDs) using Food Processor Nutrition Analysis software
- All intakes were averaged across the number of days of food records for each child to determine a mean daily intake for each beverage category.

Statistical Analysis

- A two (risk group) x four (age) repeated measures ANOVA using a mixed linear model was done to test for differences in daily beverage consumption patterns across the beverage categories and percent energy consumed from beverages as a function of risk group (high vs. low risk) and child age (three, four, five and six years). A post hoc power calculation was also done on the between-group differences found in the mixed model analyses and Cohen's D effect sizes were computed for each between-group mean differences. These analyses were also used to calculated the sample size required to replicate the findings of this study
- A series of multiple regression analyses were done to determine whether risk group, total energy intake, calories consumed from beverages and beverage intake by risk group interaction were predictors of BMI Z-score or waist circumferences from ages three to five years.

For all analyses, P-values less than 0.05 were considered statistically significant.

Data Collection Summary:

Timing of Measurements

- Children's height, weight and waist circumference were measured each year
- Children's dietary intake was measured each year.

Dependent Variables

- Variable 1: BMI Z-score was measured by calculating BMI using measured height and weight and then converting BMI to Z-scores
- Variable 2: Waist circumference was measured using a standardized procedure (waist was considered the narrowest part of the torso at the natural waist, and was measured at the end of a normal expiration).

Independent Variables

Beverage intake (ounces per day) was the independent variable in this study. Beverages were stratified into seven categories:

- Milk and milk-based beverages

- Fruit juice including 100% fruit juice
- Fruit drinks, including fruit punch, sports drinks, lemonade, instant and iced tea
- Soda including carbonated caloric beverages
- Diet soda including carbonated non-caloric beverages
- Soft drinks including soda, diet soda, fruit drinks
- Soft drinks and fruit juice including soda, diet soda, fruit drinks and fruit juice.

Control Variables

Children's risk (low or high) of obesity.

Description of Actual Data Sample:

- *Initial N:*
  - Age three: 25 boys (12 low, 12 high risk) and 20 girls (10 low, 10 high risk)
  - Age four: 23 boys (14 low, nine high risk) and 25 girls (13 low, 12 high risk)
  - Age five: 21 boys (11 low, 10 high risk) and 21 girls (12 low, nine high risk)
  - Age six: 19 boys (eight low, 11 high risk) and 23 girls (14 low, nine high risk)
- *Attrition (final N):* Two children were excluded from the Aim two longitudinal analyses because they were considered to be statistical outliers per Tukey criteria (scores exceeded 1.5 times the interquartile range for BMI Z-score and waist circumference)
- *Age:* Three to six years
- *Ethnicity:* White
- *Anthropometrics:* Authors report BMI Z-scores and waist circumference for the low and high-risk groups at ages three, four, five and six years. Only waist circumference at age six was significantly difference between risk groups. High-risk children had a significantly higher waist circumference compared to low-risk children (54.9±0.7 cm for low risk and 60.2±2.2cm for high risk)
- *Location:* Philadelphia, Pennsylvania.

Summary of Results:

Cross-Sectional Study Results: Beverage Consumption and Risk of Obesity

- Percent energy consumed from beverages: High-risk children significantly decreased energy consumed from beverages from three to six years of age, but low-risk children did not. The mean percentage of energy consumed from beverages was significantly greater among high-risk children (26±3%) than low-risk children (20±2%) at age three ($P<0.02$)
- Amount (ounces) of fruit juice: High-risk children significantly decreased fruit juice intake from three to six years of age, but low-risk children did not. Fruit juice intake was significantly greater among high-risk children compared to low-risk children at three years (13±2 ounces vs. 5±1 ounce; $P<0.0001$) and at four years (9±2 ounces vs. 6±1 ounces; $P<0.05$)
- Amount (ounces) of fruit drinks: All children's consumption of fruit drinks significantly increased over time ($P<0.01$)
- Amount (ounces) of milk: High-risk children significantly increased milk intake from three to six years of age, but low-risk children did not ($P<0.05$)
- Amount (ounces) of soda: High-risk children significantly increased soda intake from three to six years of age more than low-risk children. Soda intake was significantly greater among

high-risk children compared to low-risk children at six years (3±1 ounces vs. 1±1 ounces; P<0.04).
- Amount (ounces) of diet soda: All children's consumption of diet soda significantly increased over time (P<0.05)
- Amount (ounces) of soft drinks: All children's consumption of soft drinks significantly increased over time (P<0.0001)
- Amount (ounces) of soft drinks including fruit juice: Consumption of soft drinks including fruit juice increased over time in low-risk children while that of high-risk children remained consistently higher, except for age six. The amount of soft drinks including fruit juice consumed by high-risk children was significantly greater than low-risk children at three years (15±2 ounces vs. 7±1 ounces; P<0.0002), at four years (14±2 ounces vs. 9±1 ounces; P<0.05) and at five years (15±2 ounces vs. 10±1 ounces; P<0.04).

Longitudinal Study Results: Beverage Consumption, BMI Z-score and Waist Circumference

- There were no significant associations between change in consumption from individual beverage categories and change in BMI Z-score
- Greater increases in calories (P<0.02) and percent energy (P<0.02) consumed from all beverages and greater increases in calories consumed from milk (P=0.04) were inversely related to changes in children's waist circumference. A greater increase in calories consumed from soda (P=0.0001) was associated with a greater increase in waist circumference.

Other Findings

Changes in milk consumption from years three to five were inversely related with changes in soft drink and fruit juice consumption from years three to five for low-risk children only (P=0.02).

Author Conclusion:

The authors concluded that:

- Children who were born at high risk for obesity showed increased intakes of fruit juice and soft drinks and lower intakes of milk and milk-based beverages during early childhood compared to low-risk children
- For the group as a whole, greater increases in soda consumption from ages three to five years was associated with greater increases in child waist circumference during the subsequent years, whereas a decrease in milk consumption was associated with a greater increases in child waist circumference during the subsequent year
- Among low-risk children only, increases in milk consumption from ages three to five years were negatively associated with calories consumed form soft drinks and fruit juice.

Reviewer Comments:

- *This study used a small sample of exclusively white subjects, which limits the generalizability*
- *Results were not adjusted for potential confounders, including physical activity.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	N/A
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions

1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	???
3.	**Were study groups comparable?**	No
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	Yes
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	No

3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	No
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	No
4.1.	Were follow-up methods described and the same for all groups?	No
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	No
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	No
4.4.	Were reasons for withdrawals similar across groups?	???
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes

6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	No
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	Yes
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	No
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	Yes
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes

9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes